Towards Tunable Measurement Techniques for Available Bandwidth

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BEst 03
12 / 09 / 2003
Outline

• Our experience
  – IGI & PTR
  – PaSt

• A taxonomy of current techniques

• Challenge – tunability
IGI & PTR

- **Uniform packet train probing techniques**
  - Measure either packet gap (IGI) or probing rate (PTR)

- **Search for the turning point**
  - **Turning Point** – The smallest probing gap (largest probing rate) where it is not increased (decreased)

- **Performance**
  - Similar accuracy with Pathload
  - Smaller overhead
Paced Start (PaSt)

• Application of PTR
  – Use PTR to improve TCP startup performance
  – Similar in flavor to TCP NewReno

• PaSt uses multiple windows of data packet train to search for the turning point (available bandwidth)

• Performance [ICNP 03]
  – Less packet loss
  – Smaller startup time
What We Learned from PaSt

• Application’s considerations are very important for the measurement technique design

• Accuracy
  – IGI/PTR sometimes have 30% error, good enough?
  – TCP startup: 50% error can be easily accommodated

• Think MORE about applications!
  – TCP startup: overhead is critical
  – IGI/PTR took all effort to reduce the overhead

• Two-end control
  – Hard to deploy
  – TCP: an two end protocol
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Taxonomy of Current Techniques

- Pathload
- IGI/PTR
- TOPP
- pathChirp
- Spruce

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## Taxonomy of Current Techniques

<table>
<thead>
<tr>
<th>What to measure</th>
<th>How to measure</th>
<th>Diff.</th>
<th>common</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_bw (rate)</td>
<td>Pathload, PTR, TOPP</td>
<td>pathChirp</td>
<td>Not need B</td>
</tr>
<tr>
<td>C_bw (gap)</td>
<td>IGI</td>
<td>Spruce</td>
<td>Need B</td>
</tr>
<tr>
<td>Diff.</td>
<td>Small interval</td>
<td>Long interval</td>
<td></td>
</tr>
</tbody>
</table>

The list of techniques here is not a complete list.
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The Challenges

• Two-end control

• Accuracy vs. overhead

• Extreme environment

Deployment and Application – Tunability
Two-End Control

- Single-end control needs echo packets
- Accurate timestamp for the echo packet is hard to get

1. Tunability #1: Single-end probing
   - K.G. Anagnostakis, et.al. *cing: Measuring network-internal delays using only existing infrastructure*. Infocom 03.

2. Return path queueing
Accuracy vs. Overhead

• Accuracy is often a tradeoff with probing overhead

Tunability #2:
Enable application to configure the tradeoff between accuracy and probing overhead
Extreme Environment

• The environment where the bandwidth measurement assumptions don’t hold
  – Time measurement assumption
  – Available bandwidth determining factors

• Tunability #3:
  Deal with the environment of the future

• Wireless network
  – Available bandwidth determining factor could be different
Conclusion

• Our experience from IGI/PTR & PaSt
  – Active probing design must consider both accuracy and overhead
  – The tradeoff is closely related with the application requirement

• Tunability is the key challenge for the deployment of current techniques for available bandwidth measurement
  – Achieve single-end control
  – Understand the tradeoff between accuracy and overhead
  – Solve real system issues